

What is claimed is:

1 1. A method of forming shallow trench isolation with
2 chamfered corners, comprising:
3 forming a pad insulating layer, a first mask layer, and
4 a second mask layer on a substrate;;
5 patterning the second mask layer, the first mask layer,
6 and the pad insulating layer to form an opening
7 exposing a portion of the substrate;
8 etching the substrate using the patterned second mask
9 layer as a mask to form a trench in the
10 substrate;
11 removing part of the second mask layer to expose the
12 first mask layer adjacent to the trench and
13 result in the second mask layer having a tapered
14 profile; and
15 etching the second mask layer, the first mask layer,
16 the pad insulating layer, and the substrate along
17 the tapered profile of the second mask layer to
18 chamfer corners of the trench.

1 2. The method of forming shallow trench isolation
2 with chamfered corners of claim 1, wherein the pad
3 insulating layer is silicon dioxide.

1 3. The method of forming shallow trench isolation
2 with chamfered corners of claim 1, wherein the first mask
3 layer is silicon nitride.

1 4. The method of forming shallow trench isolation
2 with chamfered corners of claim 1, wherein the second mask

3 layer is a layer of boro phosphor silicate glass (BPSG),
4 phosphor silicate glass (PSG), boro silicate glass (BSG), or
5 arsenic silicate glass (AsSG).

1 5. The method of forming shallow trench isolation
2 with chamfered corners of claim 1, wherein the method used
3 for removing part of the second mask layer to expose the
4 first mask layer adjacent to the trench is wet etching.

1 6. The method of forming shallow trench isolation
2 with chamfered corners of claim 5, wherein the wet etching
3 uses a solution of ammonium hydrogen peroxide mixture (APM).

1 7. The method of forming shallow trench isolation
2 with chamfered corners of claim 1, further comprising, after
3 chamfering the corners of the trench, steps of:

4 completely removing the second mask layer;
5 etching the first mask layer and the pad insulating
6 layer to remove a predetermined width thereof to
7 expose a portion of the substrate adjacent to the
8 trench;

9 blanketly forming a insulator layer on the exposed
10 surface of the substrate and the chamfered
11 corners thereof to fill the trench; and
12 flattening the insulator layer, and removing the first
13 mask layer and the pad insulating layer to form a
14 trench isolation region.

1 8. The method of forming shallow trench isolation
2 with chamfered corners of claim 7, wherein the trench of the
3 trench isolation region has a Y-shaped cross-section.

1 9. The method of forming shallow trench isolation
2 with chamfered corners of claim 7, wherein etching of the
3 first mask layer and the pad insulating layer to remove a
4 predetermined width thereof to expose a portion of the
5 substrate adjacent to the trench uses wet etching.

1 10. The method of forming shallow trench isolation
2 with chamfered corners of claim 9, wherein the wet etching
3 uses a solution of hydrofluoric acid/ethylene glycol mix
4 (HF/EG).

1 11. The method of forming shallow trench isolation
2 with chamfered corners of claim 7, wherein blanketly forming
3 the insulator layer to fill the trench uses high-density
4 plasma chemical vapor deposition (HDPCVD) or low pressure
5 chemical vapor deposition (LPCVD).

1 12. The method of forming shallow trench isolation
2 with chamfered corners of claim 7, further comprising,
3 before forming the insulator layer, forming a shield layer
4 on the surface of the substrate, the trench, and the
5 chamfered corners.

1 13. The method of forming shallow trench isolation
2 with chamfered corners of claim 12, wherein the shield layer
3 is a liner oxide layer such as silicon dioxide formed by
4 thermal oxidation.

1 14. A method of forming shallow trench isolation with
2 chamfered corners, comprising:

3 forming a pad oxide layer, a first mask layer, and a
4 second mask layer on a substrate;;
5 patterning the second mask layer, the first mask layer,
6 and the pad oxide layer to form an opening
7 exposing a portion of the substrate;
8 etching the substrate using the patterned second mask
9 layer as a mask to form a trench in the
10 substrate;
11 removing part of the second mask layer by wet etching
12 to expose the first mask layer adjacent to the
13 trench and result in the second mask layer having
14 a tapered profile;
15 etching the second mask layer, the first mask layer,
16 the pad insulating layer, and the substrate along
17 the tapered profile of the second mask layer to
18 chamfer corners of the trench;
19 completely removing the second mask layer;
20 forming a liner oxide layer on the surface of the
21 substrate, the trench, and the chamfered corners.
22 blanketly forming an insulator layer on the exposed
23 surface of the substrate and the chamfered
24 corners thereof to fill the trench; and
25 flattening the insulator layer, and removing the first
26 mask layer and the pad oxide layer to form a
27 trench isolation region.

1 15. The method of forming shallow trench isolation
2 with chamfered corners of claim 14, wherein the insulator
3 layer is flattened by CMP.

1 16. The method of forming shallow trench isolation
2 with chamfered corners of claim 14, wherein the first mask
3 layer is silicon nitride.

1 17. The method of forming shallow trench isolation
2 with chamfered corners of claim 14, wherein the second mask
3 layer is a layer of BPSG, PSG, BSG, or AsSG.

4 18. The method of forming shallow trench isolation
5 with chamfered corners of claim 14, wherein the wet etching
6 uses a solution of APM.

1 19. The method of forming shallow trench isolation
2 with chamfered corners of claim 14, wherein the trench of
3 the trench isolation region has a Y-shaped cross-section.

1 20. The method of forming shallow trench isolation
2 with chamfered corners of claim 14, wherein blanketly
3 forming the insulator layer to fill the trench uses HDPCVD
4 or LPCVD.

5 21. The method of forming shallow trench isolation
6 with chamfered corners of claim 14, wherein the liner oxide
7 layer is a liner oxide layer such as silicon dioxide formed
8 by thermal oxidation.

1 22. The method of forming shallow trench isolation
2 with chamfered corners of claim 14, further comprising,
3 after removing the second mask layer, etching the first mask
4 layer and the pad oxide layer to remove a predetermined
5 width thereof to expose a portion of the substrate adjacent
6 to the trench.

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1 23. The method of forming shallow trench isolation
2 with chamfered corners of claim 22, wherein etching of the
3 first mask layer and the pad oxide layer uses wet etching.

 24. The method of forming shallow trench isolation
5 with chamfered corners of claim 23, wherein the wet etching
uses a solution of HF/EG.